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## (54) Starter Motor Brush Assembly

(57) A brush assembly for a starter motor has a support (20) mounted by screws (22) on an end bracket (11) of the motor. Pairs of slidable brushes (46, 48) (45, 47) are urged by springs (41—44) against a commutator (16), and have flexible leads (49—52) extending therefrom. The leads (50, 52) are welded to terminal plates (33, 34) which are rivetted to the support

(20) but are electrically insulated therefrom. The leads (49, 51) are welded to plates (28, 29) which are rivetted to the support (20) to be electrically connected therewith. Each terminal plate (33, 34) has an integral apertured post (57, 58) against which a connector (62, 63), secured to the field winding leads (60, 61), is held by a screw (64, 65). The whole brush assembly is replaced merely by removing the screws (22, 64, 65).

FIG.3.

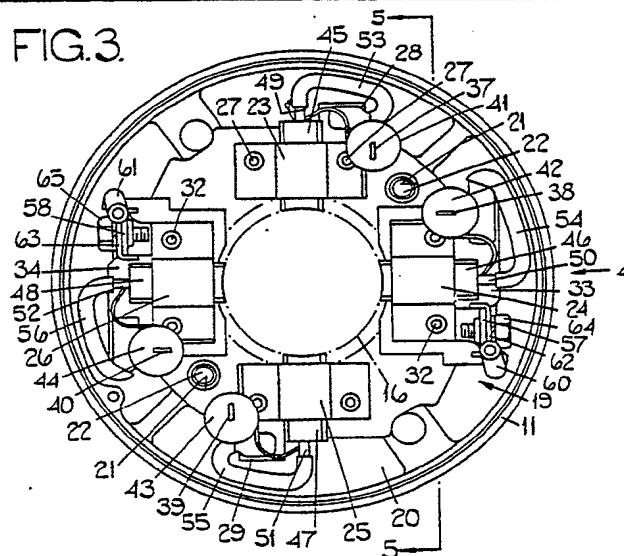
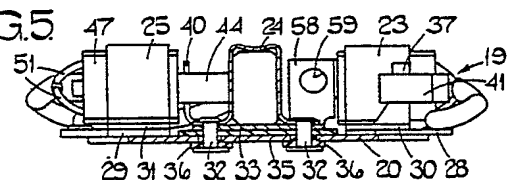


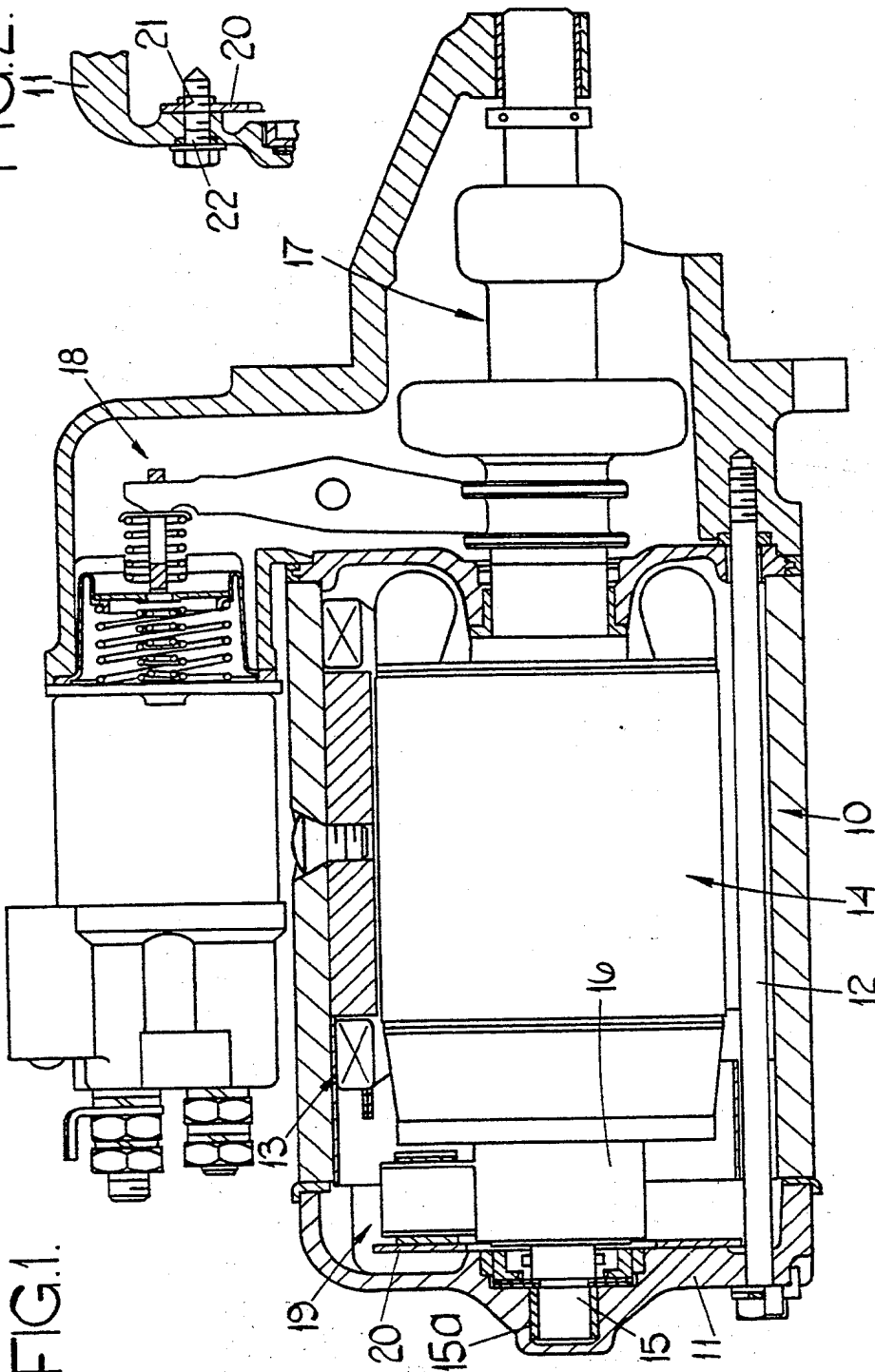
FIG.5



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FIG.2.



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FIG. 3.

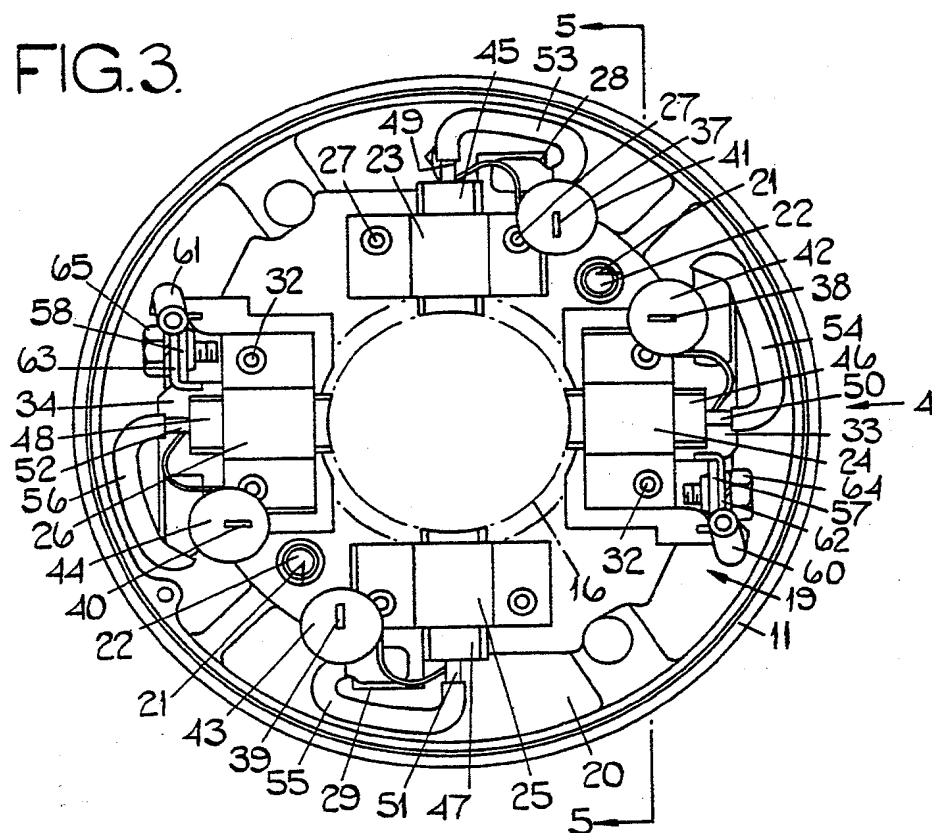


FIG. 4.

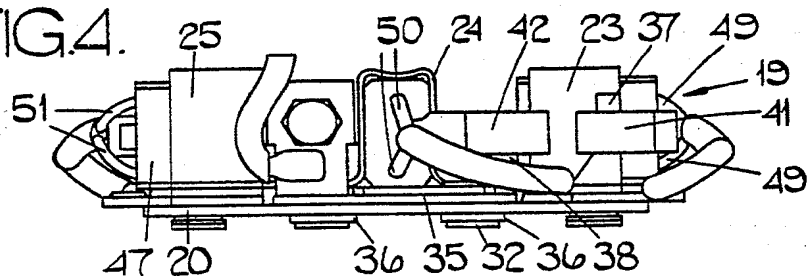
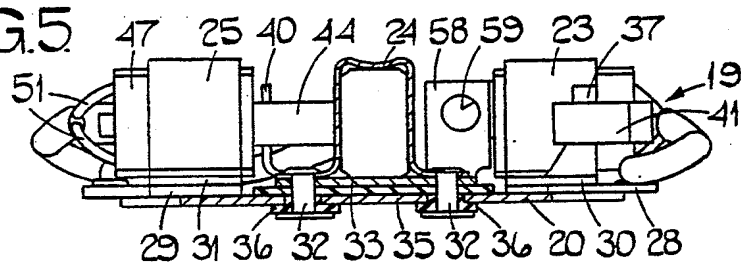


FIG. 5.



## SPECIFICATION

## Starter Motor Brush Assembly

The invention relates to a starter motor brush assembly and to a starter motor including same.

- 5 It is well known that starter motors take very heavy currents and that it is essential to ensure that all joints in the electrical circuitry in a starter motor are of as low resistance as possible to prevent overheating of the joints in service.
- 10 In one known form of starter motor brush assembly, a mounting plate is secured in electrical connection with an earthed housing of the starter motor. The mounting plate carries brush boxes in which respective brushes are slidably carried and
- 15 which are resiliently urged by springs into a position in which they contact the starter motor commutator. A pair of flexible, electrical leads is provided for each brush. Each lead has one end bonded in a respective hole in the brush and its
- 20 other end secured, usually by soldering, to a plate. In the case of those brushes which are to be connected to the field windings of the motor, each plate takes the form of a terminal end plate which is secured by the same screw which
- 25 secures a respective terminal connection of the field windings to the brush assembly. In the case of those brushes which are to be earthed to the brush box mounting plate, each plate to which the leads are secured may be either trapped
- 30 underneath the respective brush box or secured by a screw to the brush box which is then separately earthed to the brush box mounting plate. The brush boxes associated with the brushes connected with the field windings are, of
- 35 course, electrically insulated from the mounting plate although they are mounted thereon.

- Although the brushes in a brush assembly of the above-described type can be relatively easily replaced when worn by undoing the screw
- 40 connections and removing the brushes together with the leads bonded therein, it is not always possible for the screw connections to be re-made with the same effectiveness with which they were originally made in the factory. Additionally, the
- 45 tendency is to replace the worn brushes without replacing the springs which may also have become worn or corroded.

- Additionally, with the above-described form of construction, there are a relatively large number
- 50 of joints, particularly screw connection joints, all of which have to be effective to enable the starter motor to operate efficiently.

- Various brush assembly constructions are known which use a reduced number of joints
- 55 compared with the above form of construction but they generally rely on making joints between the brush leads and other parts which are difficult if not impossible to re-make satisfactorily outside the factory. As a result, with such constructions, it is difficult if not impossible to replace the brushes
- 60 at all outside the factory. Alternatively, such joints are made as solder joints. Since solder joints have a low temperature rating, they can fail during long

- starter motor operating periods through
- 65 overheating.

- It is an object of the present invention to obviate or mitigate the above disadvantages by providing a starter motor brush assembly in which the brushes can be replaced relatively easily
- 70 outside the factory whilst minimising the number of critical joints to be re-made and also making it difficult to replace the brushes without also replacing the springs and brush boxes.

- According to one aspect of the present
- 75 invention, there is provided a starter motor brush assembly comprising a support which is detachably mounted on a starter motor in use, at least one first brush and at least one second brush mounted on the support for sliding movement
- 80 relative thereto, springs biasing the brushes, at least one flexible lead extending from each brush, first means electrically connecting the or each first brush with a field winding of the motor in use, and second means electrically connecting the
- 85 or each second brush with the support, wherein the first means comprises at least one terminal plate which is (a) mounted on the support so as to be electrically insulated therefrom and (b) of the screw or like detachable connection type so as to
- 90 enable the field winding to be detachably connected thereto, the lead(s) of the or each first brush being welded to the terminal plate or a respective one of the terminal plates, and wherein the second means comprises at least one member
- 95 which is electrically connected with the support, the leads of the or each second brush being welded to said member or a respective one of said members.

- With the above form of construction, the whole
- 100 brush assembly has a relatively small number of joints and can be replaced as a unit merely by detaching the field windings from the terminal plate or plates and then detaching the support from the starter motor. The brush assembly can
- 105 be replaced without the necessity of having to undo a soldered, brazed or other permanent joint and avoids the use of soldered joints. Under service conditions where welding facilities are not available, the brushes cannot be replaced as
- 110 separate entities and therefore the complete brush assembly must be replaced. Thus, service is by way of the provision of a new, complete brush assembly. It is to be appreciated that to replace brushes by soldering is not acceptable due to the
- 115 temperature rating requirements of heavy duty starter motors of this type.

- Preferably, the or each terminal plate includes an apertured post against which an apertured connector secured to the field winding is held by a
- 120 fixing screw or like detachable element in use.

Preferably, the or each said member takes the form of a plate which is disposed under its associated second brush.

- Most preferably, a pair of separate leads is
- 125 provided for each brush, each lead being bonded at one of its ends in a respective hole in the brush and being welded at the other of its ends to the member or terminal plate, as the case may be.

According to another aspect of the present invention, there is provided a starter motor including a field winding, a rotor, a commutator mounted for rotation with the rotor, and a brush assembly comprising a support which is detachably secured to a fixed part of the starter motor, at least one first brush and at least one second brush mounted on the support for sliding movement relative thereto, springs biasing the brushes into engagement with the commutator, at least one flexible lead extending from each brush, first means electrically connecting the or each first brush with the field winding, and second means electrically connecting the or each second brush with the support, wherein the first means comprises at least one terminal plate which (a) is mounted on the support so as to be electrically insulated therefrom and (b) has a screw of like detachable connection by which the field winding is detachably connected thereto, the lead(s) of the or each first brush being welded to the terminal plate of a respective one of the terminal plates, and wherein the second means comprises at least one member which is electrically connected with the support, the lead(s) of the or each second brush being welded to said member or a respective one of said members.

An embodiment of the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:—

Fig. 1 is an axial section through a starter motor including one embodiment of starter motor brush assembly according to the present invention;

Fig. 2 is a sectional view of a detail showing the manner in which the brush assembly is mounted in the starter motor;

Fig. 3 is a plan view of the brush assembly mounted in the starter motor of Fig. 1;

Fig. 4 is a side elevation of the brush assembly of Fig. 3 in the direction of arrow 4 in Fig. 3; and

Fig. 5 is a sectional side elevation of the brush assembly on the line 5—5 of Fig. 3.

Referring now to the drawings, the starter motor illustrated in Fig. 1 is for starting an internal combustion engine of a motor vehicle and is of the pre-engaged type. Briefly, the starter motor comprises a composite housing 10 including an end bracket 11 which is secured to the remainder of the housing 10 by bolts 12 (only one shown). Within the housing 10 are mounted a field winding 13, a rotor 14 having a shaft 15 engaged in a bearing 15a pressed into the bracket 11, and a barrel-type commutator 16 mounted on the shaft 15 at one end of the rotor 14. At the other end of the rotor 14, the shaft carries a starter motor pinion assembly 17 which is rotatable with the shaft 15 but axially movable relative thereto by a solenoid operated plunger assembly 18 which is of a type known *per se*.

Also mounted within the housing 10 is a brush assembly indicated generally at 19.

The brush assembly 19 is shown in greater detail in Figs. 3—5. The brush assembly 19

includes a copper-plated steel mounting plate 20 of generally annular form and provided with a pair of diametrically opposed, plunged and internally screw-threaded holes 21 therethrough. The holes 21 receive mounting screws 22 (see also Fig. 2) by means of which the plate 20 is secured to the inside of the end bracket 11. Equiangularly spaced on a pitch circle around the plate 20 are four brush carriers 23, 24, 25 and 26. Each brush carrier 23, 24, 25 and 26 is of generally square U-shaped as can be seen from Figs. 4 and 5. Each of the brush carriers 23 and 25, which are diametrically opposite, is mounted on the plate 20 and secured thereto by rivets 27. Interposed between each brush carrier 23, 25 and the plate 20 is a respective copper connection plate 28, 29 and a respective copper spacer plate 30, 31. The rivets 27 pass through the respective plates 28—31 and serve to retain these in position. Each of the brush carriers 24 and 26 is secured to the plate 20 but is electrically insulated therefrom. Rivets 32 extend through the respective carriers 24 and 26 and through respective brass terminal plates 33 and 34 as well as through respective insulating plates 35 (only one shown—Fig. 5). The rivets 32 pass through respective electrically insulating bushes 36 and so are electrically isolated from the plate 20. Each brush carrier 23—26 is of generally square U-shaped form with a pair of feet through which the respective rivets 27 and 32 pass. Extending integrally from one foot of each carrier 23—26 and away from the plate 20 is a respective post 37, 38, 39 or 40. Mounted on each post 37—40 is a respective spiral spring 41—44. A respective brush 45—48 is mounted in the brush carriers 23—26 to be slidable radially relative thereto. The bushes 46 and 48 constitute a pair of second brushes. The springs 41—44 urge the respective brushes 45—48 radially inwardly against the peripheral surface of the commutator 16 (illustrated in dot-dash line in Fig. 3). Four pairs of flexible, braided copper strand leads 49—52 are bonded in respective holes in each brush 45—48 and extend from the radially outer end thereof. The pairs of leads 49 and 51 associated with the second brushes 45 and 47 are welded at their opposite ends to the connection plates 28 and 29 respectively whilst the pairs of leads 50 and 52 associated with the first brushes 46 and 48 are welded respectively to the terminal plates 33 and 34. Electrically insulating sleeves 53 to 56 cover the respective leads 49—52 over the majority of their length. Each terminal plate 33 and 34 includes a respective, integral terminal post 57, 58 which extends away for the plate 20. Each post 57, 58 has a plunged and internally screw-threaded hole 59 therethrough. Leads 60 and 61 from the field winding 13 which are to be connected with the first brushes 46 and 48 respectively have respective terminations 62 and 63 welded thereto. Each termination 62, 63 takes the form of a square U-shaped electrically conducting member with the inside of the base of the U-shape in facial contact with the respective

terminal post 57, 58. A fixing screw 64, 65 passes through a hole in the base of the respective termination 62, 63 and engages in the screw-threaded hole 59 in the respective terminal post 57, 58. In this way, a substantial area of contact is provided between the terminations 62, 63 and the respective terminal post 57, 58 to ensure a good electrical connection between the leads 60 and 61 and the respective first brushes 46 and 48.

The manner in which the starter motor operates is well known *per se* and its operation will not be described herein.

If a brush becomes worn or broken in service and needs to be replaced, the whole brush assembly 19 can be easily removed merely by removing the bolts 12 and 22, withdrawing the end bracket 11 from the remainder of the housing 10 leaving the brush assembly 19 in position. This enables access to be gained to the screws 64 and 65. Once these screws 64 and 65 have been removed, the whole brush assembly 19 can be removed and replaced with a fresh brush assembly. The screws 64 and 65 are then replaced and, when the new brush assembly 19 has been mounted properly in position, the end bracket 11 can be replaced and the screws 22 and bolts 12 re-inserted to complete the assembly.

In the above-described embodiment, the invention is applied to a starter motor having a barrel type commutator and radially slidable brushes. However, the invention can be applied *mutatis mutandis* to starter motors having face-type commutators and axially slidable brushes.

The present invention also contemplates the welding of the brush leads 49 and 51 directly to the mounting plate 20. A suitably modified end bracket 11 could also serve as the mounting plate 20. In the latter case, the mounting plate 20, as a separate item from the end bracket 11, would be dispensed with. Thus, replacement of the brush assembly would occur at a time in the service life of the starter motor when replacement of the bearing 15a is required. Consequently, a new bearing 15a, brush assembly and end bracket 11 would form the service unit.

#### Claims

1. A starter motor brush assembly comprising a support which is detachably mounted on a starter motor in use, at least one first brush and at least one second brush mounted on the support for sliding movement relative thereto, springs biasing the brushes, at least one flexible lead extending from each brush, first means electrically connecting the or each first brush with a field winding of the motor in use, and second means electrically connecting the or each second brush with the support, wherein the first means comprises at least one terminal plate which is (a)

mounted on the support so as to be electrically insulated therefrom and (b) of the screw or like detachable connection type so as to enable the field winding to be detachably connected thereto, the lead(s) of the or each first brush being welded to the terminal plate or a respective one of the terminal plates, and wherein the second means comprises at least one member which is electrically connected with the support, the lead(s) of the or each second brush being welded to said member or a respective one of said members.

2. An assembly as claimed in claim 1, wherein the or each terminal plate includes an apertured post against which an aperture connector secured to the field winding is held by a fixing screw or like detachable element is used.

3. An assembly as claimed in claim 1 or 2, wherein the or each said member which is electrically connected with the support takes the form of a plate which is disposed under its associated second brush.

4. An assembly as claimed in claim 1 or 2, wherein a pair of separate leads is provided for each brush, each lead being bonded at one of its ends in a respective hole in the brush and being welded at the other of its ends to the respective member or to the terminal plate.

5. A starter motor having a field winding, a rotor, a commutator mounted for rotation with the rotor, and a brush assembly comprising a support which is detachably secured to a fixed part of the starter motor, at least one first brush and at least one second brush mounted on the support for sliding movement relative thereto, springs biasing the brushes into engagement with the commutator, at least one flexible lead extending from each brush, first means electrically connecting the or each first brush with the field winding, and second means electrically connecting the or each second brush with the support, wherein the first means comprises at least one terminal plate which (a) is mounted on the support so as to be electrically isolated therefrom and (b) has a screw or like detachable connection by which the field winding is detachably connected thereto, the lead(s) of the or each first brush being welded to the terminal plate or a respective one of the terminal plates, and wherein the second means comprises at least one member which is electrically connected with the support, the lead(s) of the or each second brush being welded to said member or a respective one of said members.

6. A starter motor brush assembly substantially as hereinbefore described with reference to the accompanying drawings.

7. A starter motor substantially as hereinbefore described with reference to the accompanying drawings.